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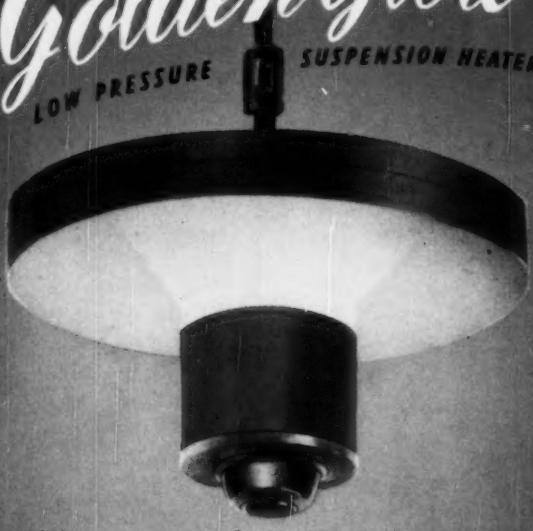

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GAS HEAT *in* INDUSTRY

Vol. XIII February, 1950 No. 149

Application of Immersion Heating to Soft Metal Melting

THE Kemp immersion heater used for soft metal melting has these well-known advantages over external heating of such a burner:—

(1) The heat of combustion can be liberated in a space entirely surrounded by the material to be heated.

(2) No heat is supplied to brick combustion chambers and flueways.

(3) Since the insulation round the pot is not in contact with hot gases it can be made more effective for a given thickness.

(4) The thermal capacity of an immersion heater is much less than that of a normal brick-lined furnace and in consequence close control of temperature is possible.

Against these advantages may be stated the practical difficulties of design, primarily combustion problems. A solution is to mix air and gas in the correct ratio in a carburettor, compress the mixture to 1-1½ p.s.i. and deliver to the burners. Such a system demands careful control to minimise risks attendant on the transport through pipelines of an explosive air-gas mixture.

Further Development

An experimental 5½ ton lead melting installation as above was extended and another plant of 11 tons per hr. capacity, feeding two autoplate machines, was installed at Carmelite House, London (Associated Newspapers Ltd.), illustrated in Fig. 1.

After the double autoplate machine had been in operation for some time the provision of a further plant was discussed. It was suggested that in place of the Holmes-Kemp system, immersion heaters fired with ordinary air blast equipment should be used. This proposal was strengthened by the requirement that the new pot should be capable of being heated by an alternative fuel (in this case, oil) and thus the burner should be capable of easy replacement in an emergency.

To discover the merits of the new proposals a 3 ton experimental pot

MAIN FEATURES IN THIS ISSUE

PAGE

IMMERSION HEATING FOR SOFT METAL MELTING ... 145

FIRING CERAMIC MATERIALS ... 149

INFLUENCE OF FURNACE ATMOSPHERES ... 154

GAS IN THE FOUNDRY ... 159

INDUSTRIAL GAS IN JOHANNESBURG ... 174

was constructed with four objectives in mind:—

(1) to prove the effectiveness of ordinary air-blast equipment in immersion heaters.

(2) to test the strength of a new design of tube, and method of firing into the pot.

(3) to obtain some idea of the thermal efficiency.

(4) to demonstrate that an alternative fuel could be used.

The two heaters consist of 6 in. dia. ¼ in. thick mild steel tubes at 8 in. centres, of horizontal U section with bottom limb projecting through the pot enabling a burner housing to be fitted, and with a vertical off-take through the metal, capped with a mild steel flue spigot throwing the products of combustion downwards over the surface of the metal to reduce dross formation. These tubes are anchored at one end only to the pot, with 3 in. by ½ in. bar iron flexible clips at the other end to allow for expansion. The sides of the pot are stiffened with 4 in. by 2 in. R.S. channel welded to the centre each side.

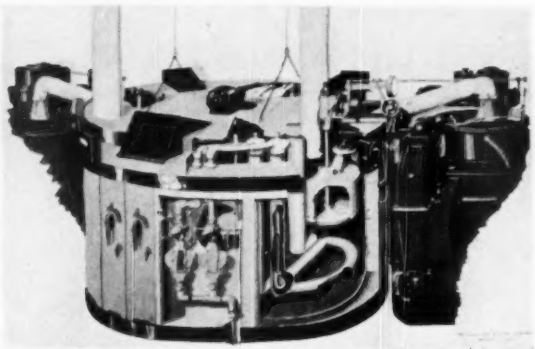


Fig. 1.
Installation at Carmelite House, London
(Associated Newspapers Ltd.)

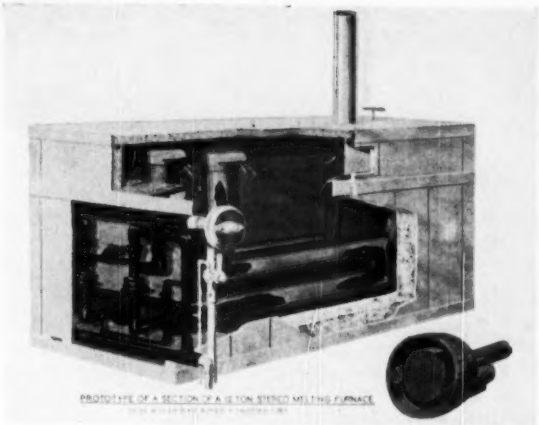


Fig. 2.
Cutaway section, showing burners

Fig. 3 shows a section through this plant, and details are given below.

Pot

This consists of ⅛ in. M.S. plate 3 ft. 10 in. by 1 ft. 6 in. by 2 ft. 7 in. deep, electrically welded inside and out, the bottom having a longitudinal fall of 1 in. to a draw-off consisting of the usual conical seated valve, operated by a hand wheel projected through the hood.

Burners

There are two cast iron burners in the form of a reducing socket, 4 in. by 2½ in. dia., having a 3½ in. dia. removable disc of mild steel drilled with 481 holes ⅛ in. dia. at ⅛ in.

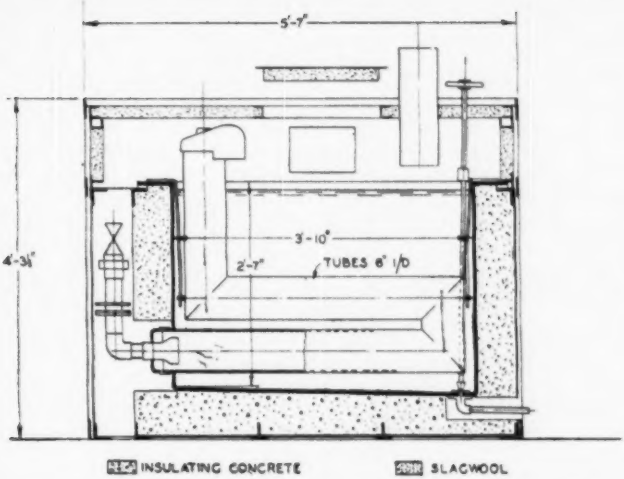


Fig. 3.
Section through three ton experimental pot

centres, countersunk inside and out, each burner having its own pilot with drilled disc of eight $\frac{3}{16}$ in. holes at $\frac{1}{8}$ in. centres and one $\frac{1}{4}$ in. hole in the centre. These are housed in a 6 in. dia. cast-iron cap complete with lighting flap, and fixed to the tubes with three $\frac{3}{8}$ in. Whit. screws. See Fig. 4B and 2.

The burner controls are housed in the end of the casing and can be completely enclosed with only the cock handles protruding and consist of two 2 in. A.2. 400 British Furnaces high velocity burners with No. 420 throats and one 6A British Furnaces governor. The maximum consumption is 500 c. ft. (2·5 therms) per hr. for each burner. The pilots are controlled separately with a $\frac{3}{8}$ in. Keith Blackman air blast injector.

The casing consists of $\frac{1}{2}$ in. mild steel 5 ft. 7 in. by 2 ft. 11 in. by 3 ft. 3½ in. deep with 7 in. packing of slag wool at the sides and ends, and 7 in. insulating concrete on the bed.

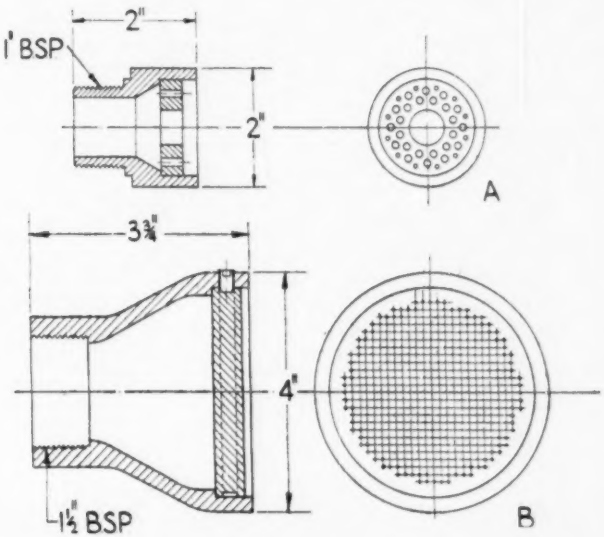


Fig. 4
Details of burners

The whole is encased with 16 s.w.g. mild steel panels on the exterior.

The hood is packed with slag wool, the roof having a removable lid 1 ft. 6 in. by 1 ft. and 6 in. dia. flue which protrudes approximately 1 in. below the level of the flue outlet of the tubular heater. A loading chute complete with roller and hinged flap is fitted to stop splashing.

Test Undertaken

The new pot was tested under the following conditions. The pot was full with about 3 tons of molten lead at a temperature of 750° F. with the appliance in a condition of thermal equilibrium; as pouring commenced, an equal quantity of cold lead was charged. This rate was subsequently found to be 7,168 lb. per hr. Results were as follows:

Ambient air temperature: 49° F.

Temperature of ½ cwt. lead ingots: 43° F.

After 30 minutes pouring and charging were stopped.

All the metal in the pot was then molten at a temperature of 745° F.

Gas consumed during the operation: 340 c. ft. (1·77 therms).

Flue gas analysis (Orsat):

CO_2: 13·0%
O_2: 0·7%
CO : nil

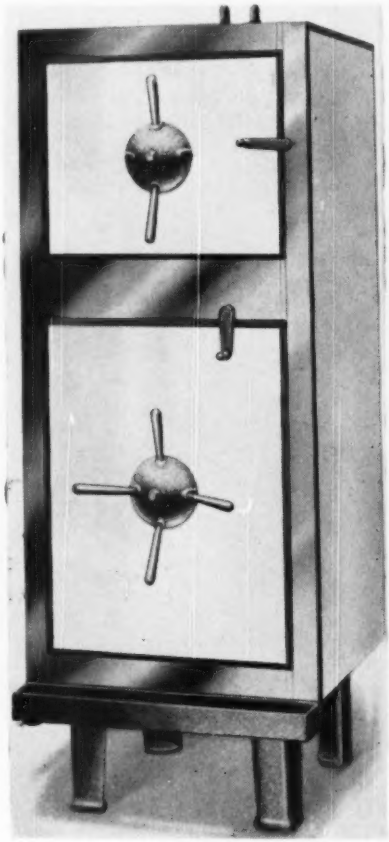
Weight of lead charged and cast: 64 pigs (½ cwt.) = 3,584 lb.

Approximate thermal efficiency: 61 per cent.

This is equivalent to 10½ lb. metal melted and poured at 750° F. per c. ft. gas (C.V. 500 B.Th.U. per c. ft.).

The pot was submitted to a series of thermal shocks in the winter of 1946/47 by applying the maximum gas rate when the appliance was cold. No leaks developed after some fifty cycles showing that the system of anchoring the immersion tube at the burner end leaving the other end floating was successful. A further test showed that "Hydran" burners consuming paraffin could be used to heat up the pot from cold to 670° F. in 2½ hours. These burners would be capable of maintaining the temperature of a stereo-pot in the event of a failure of the gas supply, and give a metal output of nearly half the normal obtained by gas.

One disadvantage of the system as first tried was the noise of the burners. The first burner consisted of two reducing sockets 2 in. by 1 in. dia. each having a 1⅜ in. dia. removable disc of mild steel drilled with twenty-four ⅛ in. holes and twelve $\frac{1}{16}$ in. holes as shown in Fig. 4a. These were mounted in the 6 in. dia. cap, one firing up and the other firing down at an angle of 30° to the horizontal, imparting a swirling motion to the flames. The burners were, however, noisy and Fig. 4B shows the later design which is described in a previous section of the report. This burner has reduced the noise to a more acceptable level.



Radiation pressure steaming oven, described on page 164

Firing Ceramic Materials

A Visit to the K.L.G. Sparking Plug Factory, South Wales

IT is well established that gas forms an admirable means of obtaining heat energy required by industrial processes. In the field of firing ceramic materials it is widely and increasingly being used.

To obtain the advancing higher ceramic firing temperatures up to 1,800° C. relatively constant quality and pressure of gas supply combined with efficient high temperature combustion technique are essential. However, in addition to obtaining elevated temperatures ceramic firing requires gradual heat energy inputs from the initial ambient temperature to the desired maximum and gradual heat recovery on the product's return to ambient temperature.

An admirable example of high temperature ceramic firing is to be found in the two "Bricesco" tunnel kiln installations at the K.L.G. Sparking Plug factory in Treforest, South Wales. These fire the famous K.L.G. Corundite Insulators used on this well-known motor-car and aircraft sparking plug. Fig. 1 illustrates one of these tunnel kilns in operation from the entry or charging end of this furnace.

Its method of loading is observed in the kiln car loaded with 18 saggars full of insulators ready to be inserted at the charging end. On the right will be seen the preparatory production flow arrangement prior to placing the charged saggars on the kiln

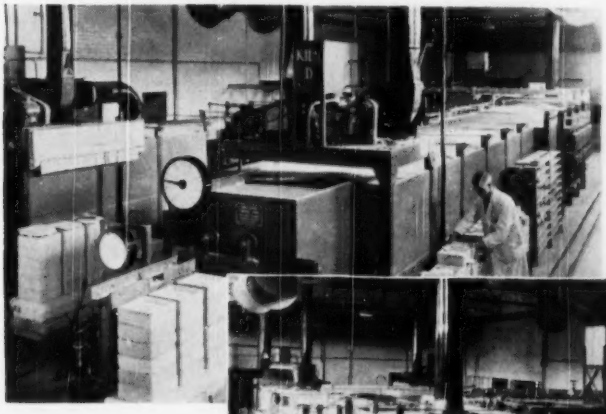


Fig. 1. Entrance under the kiln showing the trolley loaded with asbestos boxes full of insulators ready to start on their journey. On the gauge the hydraulic pressure which propels the trolleys is recorded

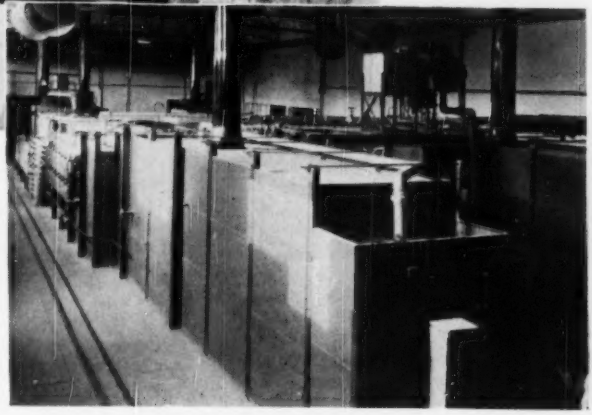


Fig. 2. From the rear the trolley is seen emerging. The battery of jets now on the left seen to be about half way down the length of the kiln. It takes 46 hours for the insulators to pass through the whole length

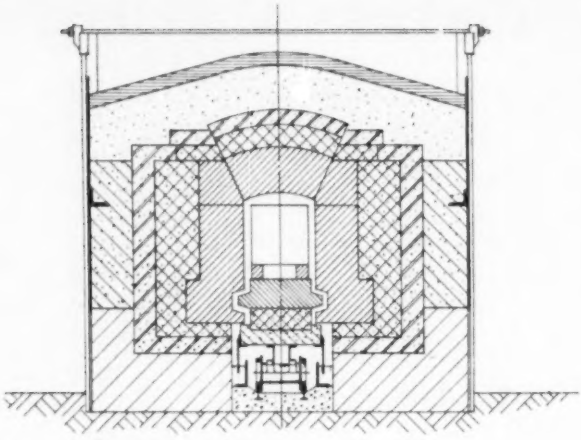


Fig. 3. A typical cross-section of the kiln

cars. Attention should be given to the deep refractory and insulation structure on each car. This prevents inoperative temperatures reaching the car bearings and also reduces heat losses.

The kiln cars are propelled through each kiln which is 67 ft. long with a cross section of 15¼ in. wide and 25 in. in height, by an infinitely variable speed "Bricesco" Hydraulic Pusher. This consists of a cylinder and ram supplied by a motor driven variable displacement oil hydraulic pump. Each car, at the time of observation, was in the kiln for 46 hours. The timing of each car and pushing effort required by the total train are recorded on the lower dial shown.

Fig. 2 shows the kiln from the discharge end with a fired car being withdrawn.

The gas multi-burner system can be seen at the left and attention is drawn to the relatively large number of burners in so short a high temperature kiln. Ample firing zone control is thus obtained. The heat energy input is automatically maintained at approximately 1,440° C. for initial firing or 1,395° C. for glaze firing. These kilns, however, are designed and have operated up to 1,650° C.

The gas input per kiln is approximately 2,000 c. ft. per hour or 9·5 therms for a kiln throughput of about 1,000 insulators per hour. In the manufacture of sparking plug insulators and other high temperature ceramics great attention is paid to the composition and in the case of K.L.G. sparking plugs a high alumina content is used with a powerful binding medium. These constituents combined with correct firing produce the highly essential properties of good dielectric constants with resistance to failure due to thermal shock of a very high rate of temperature change.

Fig. 3 shows a typical cross section of such a kiln which in addition to heat energy control embodies air input and exhaust fans with other control devices to maintain a satisfactory oxidising kiln atmosphere. Thus by the correct application of Gas Fuel one can obtain the temperature levels and gradients required to fire high grade ceramics when combined with precise combustion and furnace engineering design and construction. We are indebted particularly to Mr. A. E. Postlethwaite and Mr. Comer of the K.L.G. Company Ltd. and The British Ceramic Service Company Ltd. for relevant data and illustrations herein.

B.C.U.R.A. Gazette.—We have received the quarterly B.C.U.R.A. Gazette, obtainable from the British Coal Utilisation Research Association, Randalls Road, Leatherhead, Surrey. In issue No. 6 feature articles deal with Gas Producer Research, Solid Fuel Combustion and Heat Transfer in Shell Boilers.

A Method for Insulating Heated Solution Tanks

FUEL saving is always of interest—not merely from the national viewpoint but because it can mean real saving in production costs in days of ever-increasing fuel prices.

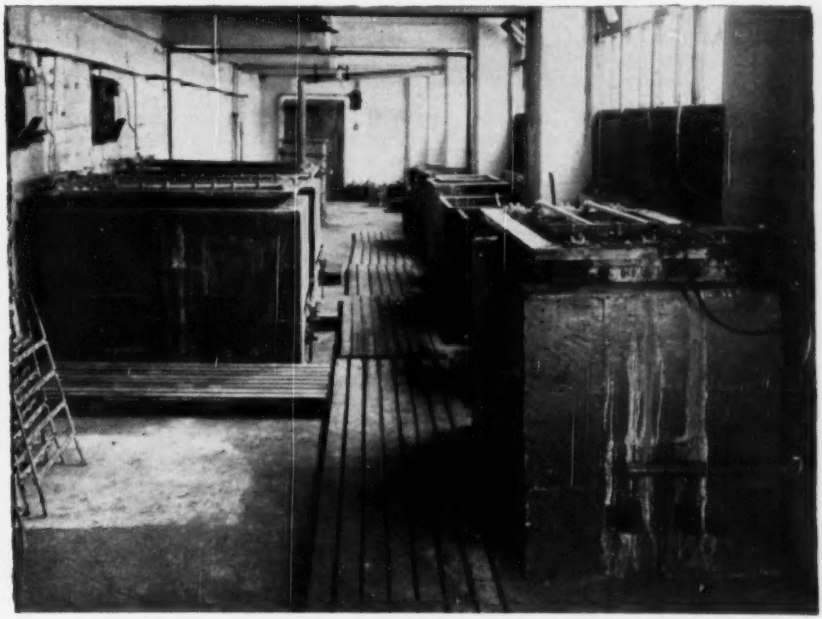
Tank heating is most important in electroplating, derusting, pretreatment, etc. These tanks are usually rectangular, made from sheet steel, and supported on a base. They are heated by either gas rail burners underneath, steam pipes immersed in the solution, or by electric immersion heaters. This is often wasteful, because in the case of gas heated tanks, the products of combustion continually escape from the bottom of the tank long before they have heated the contents to the required temperature, whilst extensive radiation losses are incurred in the case of immersion heated tanks.

New Type Insulating Brick.

The Reymor Brick Co. Ltd. have co-operated with an industrial gas engineer in the West Midlands, and taken out a patent on a new type of interlocking, precast insulating brick. They have carried out many installations at works in that area and elsewhere, resulting in a considerable reduction in fuel consumption in all cases. Some test figures show reductions of up to thirty per cent. in fuel costs, and the overall cost of insulation has been recovered within twelve months.

Reymor bricks can be assembled round any heated metal tank, by unskilled labour, in the shortest space of time, without the use of mortar or any other jointing material. They are tongued and grooved, and can be taken apart as easily as they can be assembled. The company experimented with a great many materials, but finally found that a mixture of sand, ciment fondu and Vermiculite offered one of the best combinations.

The bricks are soft enough to be cut or sawn with ease, but are robust in production usage. When assembled round



Rows of tanks, encased with Reymor bricks at Bodill-Parker, Birmingham, brass founders and platers

a heated tank, holes can be cut to admit gas pipes, injectors or other fittings, and to provide secondary air inlets and flue outlets where necessary.

Each brick is rectangular in outline and of standard thickness, formed with a tongue on one edge and a groove in the opposite edge. Specials are provided for corners, called long angle bricks and short angle bricks. These comprise two integral parts extending at right angles to each other, one having a groove in its outer edge and the other a tongue, to key with the tongues and grooves of the bricks in the walls. The flat bricks are available in three different sizes, 6 in. × 6 in. × 2 in., 12 in. × 6 in. × 2 in., and 12 in. × 12 in. × 2 in.

A heat-insulating shell can be built up from these bricks in a very short space of time, and without having to put the tank or tanks temporarily out of action. A combustion space is always left between the tank and the inner surface of the shell.

Long and short cover bricks are provided to finish off the upper edges of the side walls, and to meet the surface of the tank to close in the combustion space. These covering members are stepped to fit flush on to the bricks in the top course, and they are rounded on one upper edge to provide a neat finish. Some cover bricks are supplied mitred for use at corners.

If a row of tanks is installed so closely in line that the erection of bricks between them is impossible, the whole line may be treated as one large tank. In such cases the company will supply a detailed layout specifying the types of bricks to be used. It is, however, advisable to consult local gas departments as well, as they will be in a position to indicate in what places and of what size the necessary openings for air holes and flue outlets should be cut. Finally, to prevent deterioration of the bricks by spillage, it is an advantage to paint the whole structure with anti-corrosive paint.

Tanks thus enclosed not only reach the required temperature more quickly, but will hold this temperature longer, when the fuel service has been cut off.

We are indebted to the Reymor Brick Co. Ltd., Church Lane, Wolverhampton, for the above information and illustration.

South Eastern Gas Board's New Staff Restaurant and Kitchen

THE new staff restaurant at the South-Eastern Gas Board's headquarters at Katharine Street, Croydon, has been formed within the existing basement, which was the only space available. By careful planning, particularly in the lighting and decorative schemes, the natural difficulties have been overcome and the result is an attractive restaurant and an efficient kitchen equipped to serve 500 meals a day.

The method adopted to overcome the absence of natural ventilation is of interest because it was partly determined by the existing building and air-conditioning plant. Conditioned air is introduced into the main dining-room through diffusers in the ceiling, extracted through grilles in the doors via the kitchen and discharged into the open some distance from the building. This process keeps the kitchen cool and prevents the smell of cooking from reaching the upper floors of the building.

A logical sequence of cooking operations is permitted by the layout of the equipment, and tiled floors and walls with coved skirting and rounded corners reduce the labour of cleaning. Vermiculite plaster ceilings in both restaurant and kitchen together with air extract plant prevent and dispose of the usual condensation troubles. Meals are served from the kitchen through a hot closet, which is raised to prevent unecessary stooping by the kitchen staff.

Furnishing generally is in light oak, the table tops and counter being covered with buff and pink formica, a fire-resisting and easily cleaned plastic material. The colour scheme of the restaurant is cream sprayed walls and ceiling with dark red skirting and bands in the buff coloured floor.

The Appliances

Following is a complete list of the apparatus installed:

4 elevated "Chester" double oven gas ranges. Ovens fitted with "Regulo" controls.

1 No. 23 "Wardour" fish fryer, complete with back and side screen.

1 No. 757 "Chester" boiling table.

1 double No. 4158 compartment vegetable and pudding steamer.

2 "Lune" vegetable boilers, 20 gallons capacity, complete with hinged counter-balanced lid.

1 No. 30-2 "Confector" pastry oven.

1 cooling rack, wall hinged pattern to take six trays.

1 stainless steel table, 3 ft. 6 in. × 2 ft. 3 in.

1 "Belgravia Minor" hot closet, 10 ft. long × 2 ft. 6 in. deep × approximately

This new staff restaurant at the South Eastern Gas Board's headquarters at Katharine Street, Croydon, is equipped to serve 500 meals a day

Meals are served from the kitchen through a hot closet which is raised to prevent unnecessary stooping

2 ft. 10 in. high overall, sliding doors both sides.

1 "Holborn" bain marie, 2 ft. × 2 ft. 6 in.

2 stainless steel tables, each 4 ft. × 2 ft. 6 in.

1 dirties table, 10 ft. × 2 ft. 3 in. × 2 ft. 10 in. high.

1 stainless steel drainer, 11 ft. × 2 ft. 3 in. with double compartment sink, each compartment 30 in. × 20 in. × 10 in. deep on tube legs.

1 11 ft. hygienic plate and cup rack with brackets.

1 angular stainless steel wall bench, 31 ft. long × 2 ft. 3 in. with one double and two single compartment sinks, each 30 in. × 20 in. × 10 in. deep, on tube legs.

1 No. 6114 "Hobart" potato peeler.

3 stainless steel centre tables, 5 ft. × 2 ft. 3 in. with drawer and shelf under each.

1 No. 27 "C" pattern "Savoy" griller.

1 stainless steel table, 5 ft. 6 in. × 2 ft. 3 in., with one shelf under extended to 8 ft. 6 in. × 2 ft., one drawer and 12 in. wide shelf over 5 ft. 6 in. long.

1 No. AE 200 "Hobart" mixer, with 10 qt. equipment and mincer attachment.

1 100 c. ft. "Prestcold" coldroom, with separate fish section.

1 Maxol tea and coffee set, No. BD. 2, with 2 gallon milk and coffee urns.

1 12-tray proving oven.

4 tea service trolleys, 3 ft. 10 in. × 1 ft. 10 in. × 3 ft. high, fitted with 6 gallon tea urn.

5 sections slatted floor racks.

1 wall bench and 2 shelves over.

1 No. LEIC. "Hobart" dish washer, with 4 ft. of inlet and outlet tabling.

1 No. 1324 stockpot stand.

1 tubular steel trolley.

TUNNEL KILNS IN CERAMIC INDUSTRY

PORCELAIN works in France, says *Chemistry and Industry*, are installing more and more tunnel kilns in place of the old, round, two-stage kilns.

The plant generally consists of a 20 metre kiln for preliminary firing, having a capacity of 2,000 kg. per 24 hr., and an enamel-firing kiln 56 metres long, which can produce 3,000 kg. per 24 hr. The latter consists of a preheating chamber 28 metres long, a main firing chamber 11 metres long and a cooling chamber 17 metres long the two kilns are heated by purified low-grade gas from a gas producer. Perfect uniformity and control of temperature are obtained inside the kilns, which are equipped with automatic regulating devices, and as a result there is much less loss of shape in the articles than in intermittent kilns.

The Influence of Furnace Atmospheres in Vitreous Enamelling

Our Report of a Paper by

S. E. A. RYDER, B.Sc., F.R.I.C.,

and G. W. CULSHAW, Ph.D., F.R.I.C.

EXPERIENCE shows that "scumming" is connected with conditions inside the muffle, in particular from products of combustion. Also some types of frit are more susceptible than others.

Institute of Vitreous Enamellers—Annual Conference, October, 1949

The use of town gas-fired furnaces has shown that infiltration of flue gases, sufficient to give 1 per cent. of carbon dioxide in the muffle atmosphere, does not cause scumming with any frit, but if 3 per cent. is present scumming will probably occur on zirconium or antimony enamels, but not on acid-resistant titanium enamel. Such reference to 3 per cent of carbon dioxide in the muffle does not suggest that it is the cause of the scumming. The percentage of carbon dioxide present is used as a measure of the amount of flue gas entering the muffle, because it is the easiest flue-gas constituent to determine.

The necessity to maintain a high degree or purity in the muffle atmosphere places severe limitations on the furnace designer and, no doubt, if enamel could be fused without loss of gloss in an atmosphere containing appreciable amounts of products of combustion, the considerably higher thermal efficiencies could be obtained, together with savings on capital costs of the furnace. This applies particularly to town gas-fired furnaces where the flue gases are quite free from particles of ash, or incompletely burned fuel.

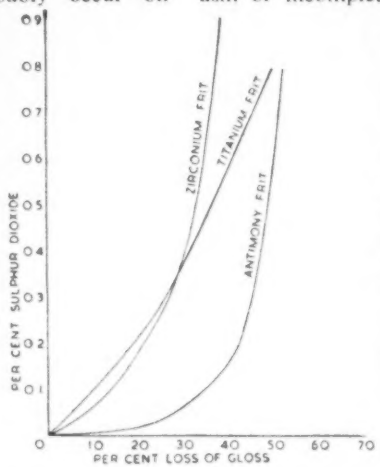


Fig. 1. Effect of fusing in sulphur dioxide atmosphere

Cause of Scumming

Scumming is usually attributed to sulphur contained in the fuel, and one American authority has stated that as little as four parts per million of sulphur trioxide in the atmosphere is injurious, but the trouble is certainly not unknown with electric muffle fusing where no sulphur compounds can arise from the fuel. From experience it is reasonable to

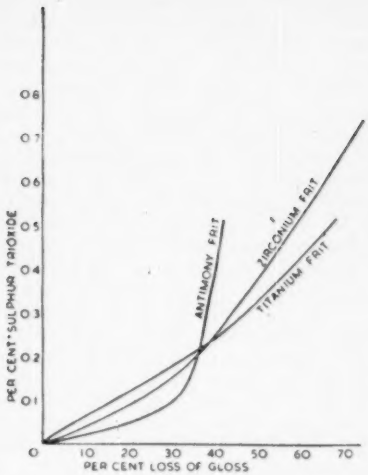


Fig. 2. Effect of fusing in atmosphere containing sulphur trioxide

suppose that scumming is caused by a constituent of the flue gases not present to any great extent in air. These of course are oxides of sulphur, carbon dioxide and water vapour.

The effect of these compounds individually was studied by fusing enamelled plates in contaminated atmospheres.

Method of Investigation

The apparatus used consisted of an electrically heated laboratory muffle, internal dimensions 3¼ in. by 5⅜ in. by 11 in., giving a cubic capacity of approximately ¼ c. ft. Into the back of this was passed air at the rate of approximately 10 c. ft. per hour and known amounts of contaminants were added to the air stream at some distance before the muffle so as to ensure thorough mixing. This gas rate gave an average air change in the muffle of more than one per minute, and it was shown that under these conditions the muffle atmosphere was almost identical with the stream passing into it.

This stream was filtered, dried and passed through a tower packed with "Carbest" to absorb any acid gases such as carbon dioxide or sulphur dioxide, and then metered by calibrated flow gauge before entering delivery tube to the furnace. The contaminating gases were purified, where necessary, metered by flow gauge and passed into the air stream. The source of sulphur dioxide was a syphon of liquid sulphur dioxide, while the carbon dioxide was obtained from a cylinder of compressed gas. Sulphur trioxide was obtained by passing the mixture of air and sulphur dioxide through a tube packed with platinised asbestos and heated to 400° C. A high proportion of the sulphur dioxide was oxidised, but no doubt a considerable amount dissociated again in the muffle at 830° C.

Known amounts of moisture were added to the muffle by passing a subsidiary air stream through saturators maintained at constant temperature in a water bath.

Glossmeter Readings

The effect of the various contaminants on the fused enamel was determined by a Photovolt glossmeter. For each test run a number of plates were sprayed with the same batch of milled enamel and dried under identical conditions in pure air. At the commencement and end of each experimental run two plates were fired with pure air only passing into the muffle. The glossmeter reading of the four plates gave good agreement and was given an arbitrary value of 100. The gloss of the enamel fired in contaminated atmospheres is reported as a percentage of the gloss reading obtained for the blank.

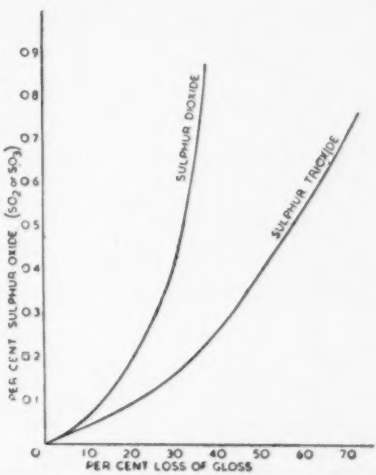


Fig. 3. Effect of sulphur trioxide atmosphere on zirconium frit

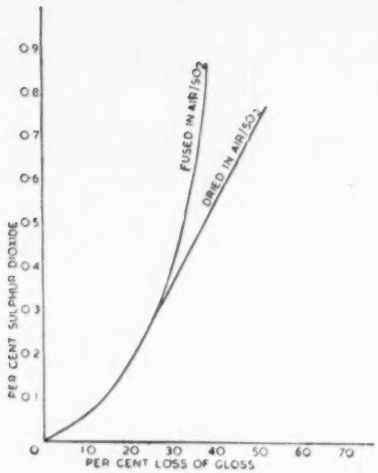


Fig. 4. Effect of sulphur dioxide in atmosphere during drying

Three types of frit were examined, viz. an acid-resistant titanium frit, a high-opacity zirconium frit and an antimony frit.

At each concentration of contaminant two plates were fused in the muffle, one after the other. On each of the plates five readings of gloss were observed by the glossmeter and all the readings averaged. With this procedure reasonable agreement was obtained between the individual plates of each pair and also no difficulty was experienced in reproducing the results.

Experimental Results

The results of adding various amounts of sulphur dioxide to the air are shown in Fig. 1, in which loss of gloss has been plotted against sulphur-dioxide concentration.

Fig. 2 shows the results obtained with air contaminated with SO_3/SO_2. Oxidation of some of the sulphur dioxide to sulphur trioxide has considerably increased the scumming effect on the titanium and zirconium enamels. In order to illustrate this increased effect in the case of the zirconium frit, the results for sulphur-dioxide contamination and SO_3/SO_2 contamination are given in Fig. 3.

It is seen that 0·05 per cent. sulphur dioxide gave 9 per cent. loss of gloss, while oxidation to sulphur trioxide increased the loss of gloss to 13 per cent. The effect on the titanium frit was similar, but on the antimony frit sulphur trioxide had no greater effect than sulphur dioxide. It is apparent from these results that oxides of sulphur do play a considerable part in the scumming of enamels during fusing.

The effect of carbon dioxide was next investigated. Plates sprayed with titanium, zirconium and antimony frits were fused in atmospheres containing varying amounts of carbon dioxide ranging from 1 to 20 per cent. and in no case was loss of gloss experienced.

The effect of the third major flue-gas constituent, water vapour, was then investigated. Various amounts of water vapour up to a maximum of 40 per cent. were used and all three frits were fused in these atmospheres, but in no case was any loss of gloss detectable.

It appears from these results that of the major flue-gas constituents oxides of sulphur are the only ones which alone can cause scumming.

No Increased Effect

It was thought that although carbon dioxide or water vapour alone would not cause scumming, yet either or both may increase the effect produced by sulphur compounds, when they are present together as in flue gases. Varying amounts of carbon dioxide were added to an air stream containing known amounts of sulphur dioxide and also to a stream containing known amounts of sulphur trioxide, and in no case was the loss greater than would be expected from the presence of the sulphur oxide alone.

The effect of a combination of sulphur dioxide with water vapour in the muffle atmosphere was investigated with all three frits, and in no case did the presence of water vapour increase the effect of the sulphur dioxide.

The effect of a combination of carbon dioxide and water vapour added to the muffle atmosphere was investigated in the case of all the frits and again no scumming could be produced.

Combinations of carbon dioxide, water vapour and sulphur dioxide, and combinations of carbon dioxide, water vapour and sulphur trioxide were next tried with all three frits. In each case the combination of the three constituents was found to cause no more

loss of gloss than the corresponding amount of sulphur dioxide or sulphur trioxide alone in the atmosphere.

Consideration of Results

From the results presented it appears that the only constituents of flue gases responsible for scumming of enamels during fusing are the sulphur oxides. While the foregoing results clearly indicate that this is so, it is felt that more experimental work is needed to finalise the results, and there are a number of outstanding points requiring elucidation. If, however, further work confirms that the sulphur compounds are the sole source of scumming during fusing this may be of value in furnace design.

For instance, if sulphur compounds are eliminated from town gas it would not be necessary to use muffles for fusing with this fuel; open furnaces could be used with consequent saving in capital cost and fuel. It is known that for some years one of the large gas undertakings in the Potteries has gone to great lengths to reduce the sulphur content of the gas it supplies to such a figure that pottery can be fired in gas heated kilns without the use of sagars, where formerly these were essential.

If a supply of gas with a sufficiently low sulphur content cannot be obtained from the local undertaking, would it be worth while to install plant to treat the furnace fuel gas (for instance, an active carbon-absorption plant) and so reduce the sulphur content?

Scumming in Electric Furnaces

It has been mentioned earlier that scumming has been known to occur occasionally in electric enamelling furnaces in which there can be no question of atmosphere contamination by products of combustion. One explanation of this has been that it is due to water vapour which is given off by the enamel and accumulates in the furnace atmosphere. The results obtained with the laboratory apparatus described here do not support this view.

Enamel may, of course, be exposed to sulphur contamination apart from the fusing stage in the furnace. One likely source is during the drying operation. Do sulphur compounds in the dryer atmosphere have any effect on the finished ware? In order to check this point, plates sprayed with zirconium frit were dried in atmospheres containing varying amounts of sulphur dioxide and sulphur trioxide, and subsequently fused in a pure air atmosphere.

The results for sulphur dioxide are shown in the graph (Fig. 4). For comparison purposes the results of fusing the same frit in similar atmospheres have been included.

It is seen from this graph that sulphur dioxide in the dryer atmospheres has as much effect as in the muffle atmosphere, while preliminary results indicate that the same is true in the case of sulphur trioxide. It is possible, therefore, that when scumming trouble has been experienced with electric furnaces, the source of this trouble may not be in the furnace at all. Few enamellers pay much attention to the chemical composition of their dryer atmospheres and, in many cases, products of combustion of gas are used directly for drying.

It has been mentioned that it is not considered that the results presented in this paper are complete. There are several reasons for this. Under the laboratory conditions, a minimum sulphur - oxide concentration in the region of 0·05 per cent. by volume was required to produce significant scumming effects. This is very much greater than could possibly be obtained in a town gas-fired muffle with a sulphur content in the gas in the region of 20 grains per 100 c. ft., although it may be attained in an oil-fired muffle. It has not been possible to find a reason for this.

Although experiments have been carried out with the principal constituents of products of combustion, there are also present oxides of nitrogen. They are present in very much smaller amounts than the other constituents, but it is felt that it would be worth while investigating their effect when opportunity permits.

It has been shown that contamination of dryer atmospheres is as serious a matter as contamination of muffle atmosphere, and it would be advantageous to investigate whether the effects of contamination at these two stages are additive.

All the plates processed in these

experiments were fired at 830° C. for 3½ min. and all the plates used in the dryer-atmosphere experiments were dried at 150° C. for 6 min., and this paper therefore does not present any information as to the effect of length of times of exposure to contamination, either during fusing or drying. This information would be valuable.

Only one standard milling has been used for each frit in these experiments, but it would be interesting to know whether milling formula has any significance. For instance, would a more alkaline slip tend to absorb more sulphur oxide during drying than one with a lower *p*H value?

In conclusion it is suggested that there is room for much more investigation into the effects of the atmospheres to which enamelling frits are exposed during the various stages of application. For many years the Institute has considered carrying out or sponsoring research work in the interests of the industry, but has been hampered by lack of funds which has prevented the introduction of any ambitious research programme. An investigation along the lines indicated in this paper would not require elaborate or expensive apparatus, and would not be beyond the resources of the Institute, but would be fruitful in supplying useful information.

Acknowledgment is made for help received from colleagues in carrying out the experimental work and to the directors of Stoves Ltd. for permission to publish the information.

(*Industrial Finishing (British), a publication of Arrow Press Ltd.*)

C.F.2 SEALS AND PACKINGS

ON the 26th January a demonstration of C.F.2 products (manufactured from polytetrafluoroethylene) was organised by Crane Packing Ltd. and held at the Park Lane Hotel, London. Crane's are manufacturers of gland packings and mechanical seals; a subsidiary company of Tube Investments Ltd.

The products featured were gland packings, pipe jointings and valve seatings which have been developed for use with chemicals and acids of a highly solvent or corrosive nature.

Polytetrafluoroethylene is a new plastic material, a polymer containing carbon and fluorine atoms only. It is manufactured in the form of a white granular powder, and to transform it into the range of products to which has been given the name C.F.2 it is passed through a series of carefully controlled processes.

The result is a range of gland packings possessing unique properties, they are chemically inert, thermally stable, non-toxic, and have good mechanical properties and a low coefficient of friction. In their solid moulded form C.F.2 gland packings are claimed to meet the requirements of the most severe gland service conditions, for they will withstand the corrosive and solvent action of any known acid or chemical, even when they are handled at higher than average pressures or at temperatures as high as 450° F. or as low as — 60° F.

Other forms of packings are available, such as those which are constructed by spirally wrapping or braiding C.F.2 tape round a core of suitable material, or those composed entirely of C.F.2 tape in braided jacket over jacket construction. C.F.2 is also supplied in cord form for packing valve spindles, and in loose shredded form for certain applications.

EXHIBIT AT ENGINEERING CENTRE, GLASGOW

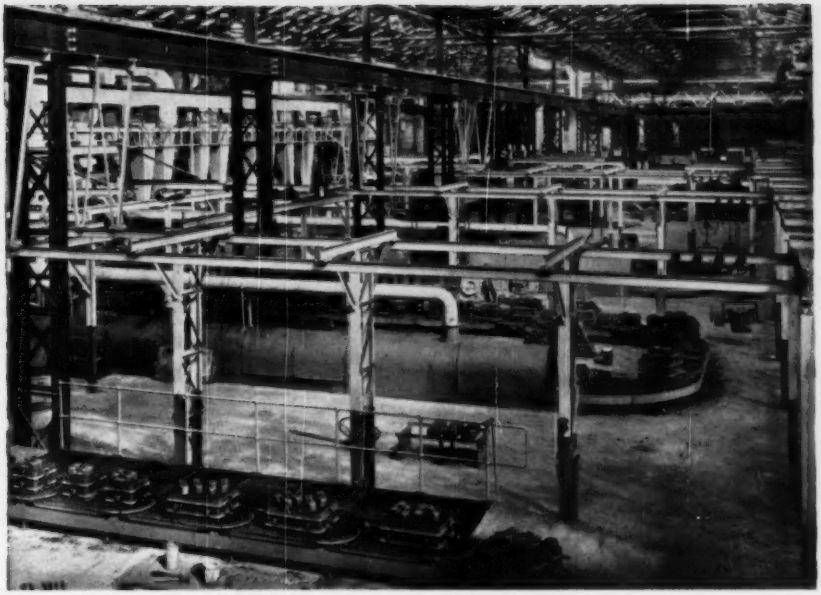
THE British Thermostat Co. Ltd. announce that they will be exhibiting at the Engineering Centre, Sauchiehall Street, Glasgow, where they are displaying a representative selection of products.

These include controls for temperature, pressure, humidity and flow, for use in applications such as refrigeration, heating, air-conditioning, industrial processing, etc.

Publications giving details of the various instruments on show are obtainable from the Centre.

BRITISH WELDING RESEARCH ASSOCIATION

IN the series of "Techniques and Memorandum," the Welding Research Association have published a booklet entitled, "Heat Treatment of Welded Constructions in Mild Steel." This may be obtainable, price 1s. 6d., from the Association at 29 Park Crescent, London, W.1.



A view of the mould conveyor units, showing overhead runway system

Another Example of Gas in the Foundry

Based on Information Supplied by Ruston & Hornsby Ltd., Lincoln

A GREAT step forward in foundry history is evident from the new Beevor Iron Foundry of Ruston and Hornsby Limited, the begining of which goes back to 1945, when considerable extension of the manufacturing capacities of the Ruston foundries became necessary, owing to the ever increased demands for iron castings for oil engines, diesel locomotives, pumps, excavators, etc.

Visits were made by Ruston representatives to modern plants in Europe and America, to ascertain the extent to which modern mechanical methods could be most effectively applied, and plans were prepared for an additional capacity of some 250 tons of castings per week. The new foundry was built to provide this but planned for future extensions.

With the shortage of skilled labour it was felt that future requirements of intricate castings could be met only by employing methods which would enable skilled labour to be used to the best advantage. The policy decided upon, therefore, was to employ job-breakdown wherever possible and so ensure that the limited amount of skilled operators would be utilised only for such operations as called for skilled ability.

Fully alive to the important question of working conditions and amenities, plans included a separate Amenities

View of some of the sixteen moulding machine stations

building, comprising locker, washing, shower bath and rest-room facilities for both male and female labour, while to improve working conditions in the shop such items as shop heating, dust and fume extraction, hot and cold air inlets and a comprehensive extract ventilation installation were included.

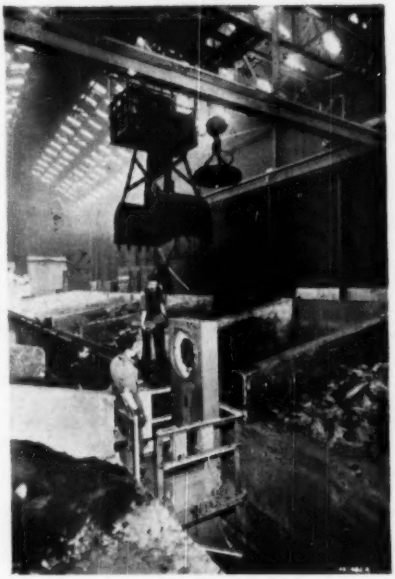
The buildings cover a total floor area of 115,000 sq. ft., consisting of five bays each 50 ft. wide, parallel to each other, three of which are 350 ft. long and two 325 ft. long. These constitute the main production bays for coremaking, sand treatment, moulding, casting and fettling. In addition, there are two further bays at right angles to these, 60 ft. wide, one 300 ft. long and the other 200 ft. long, which are utilised for raw material handling, melting, storage, various services and distribution purposes. The complete cycle of operations is under cover, and ample room has been allowed for wide gangways to facilitate mechanical transport, with liberal working space for each operation.

In order to ensure good atmospheric conditions at working level the building was constructed as high as possible, the height to the crane rails being 24 ft., to the eaves 32 ft., and to the ridge of the roof 43 ft.

Moulding Plant

The required production of moulds has been obtained by dividing the plant into five unit systems, each of which has been designed to produce a particular range of product under continuous and progressive processing methods.

The green sand mechanised production plant comprises four of these units and is served with one central sand handling and preparing plant. Rammed moulds are conveyed mechanically to the casting operation, after which the conveyors pass through a fume exhausting tunnel to the shake-out stations. Used sand from each shake-out is fed continuously on to a common return belt conveyor on which all metal is separated by means of an over band magnet separator. The sand is then broken up in a disintegrator before being elevated to a rotary screen and permeability controller. From here the sand is discharged on to another belt conveyor which delivers it direct to three 40 ton



General view of the furnace raw materials handling equipment

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capacity storage hoppers over three batch mills.

New sand is delivered by rail to the cross service bay, from where it is unloaded on to an apron conveyor system which feeds mechanically to points over the mills for addition during the re-milling operation. Mixed sand is discharged on to a slow-moving belt conveyor from where it is elevated to an aerator which discharges to the main feeding belt into the various moulding machine hoppers.

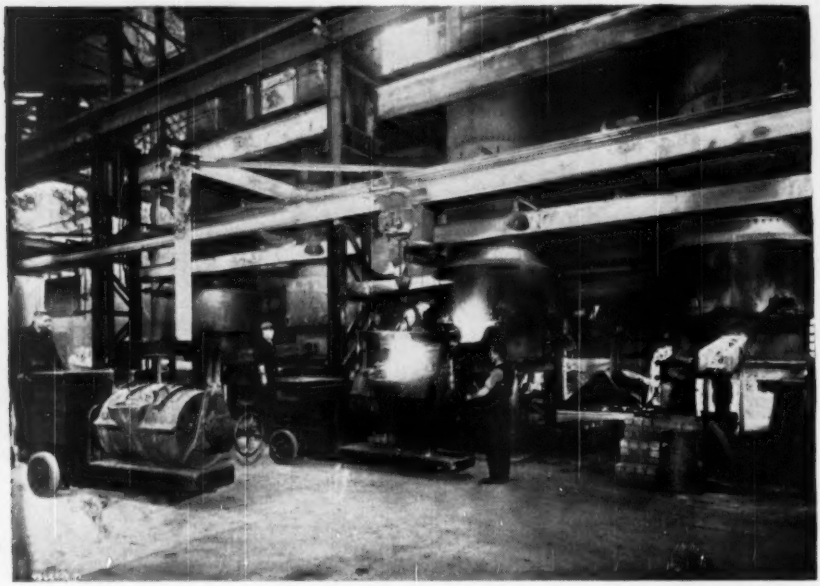
The fifth unit is designed for progressive dry sand mould making, closing and casting, for which a separate intricate sand system is incorporated, comprising both facing and backing sand systems.

Melting Plant.

Here all handling is done under cover, metal and coke being unloaded into bins from the rail trucks by means of overhead crane magnet and grab respectively.

There are four cupolas, lined to 42 in. diameter, in the melting plant, two of which are operated each day. Each cupola melts 6-7 tons of iron per hour and the base metals from each can be either mixed or treated separately, at the spouts, with alloy or graphitising additions to make them suitable for a variety of requirements. "Selas" gas torches are used for lighting the cupolas. These have a 1 in. gas supply and a $\frac{1}{2}$ in. compressed air supply, with a gas consumption rated at 750 c. ft. per hour.

Molten cast iron is tapped into a drum type distributing ladle for delivery to the various casting stations by means of electric trucks. This method of metal transport is unusual but has proved to be most satisfactory, safe, and fast means of transport.



View of the four cupolas at the time of tapping the molten metal into drum type ladle, for transport to casting stations

From the drum ladle, molten iron is transferred into geared casting ladles, suspended on travelling rack hoists on an easy run mono-rail system, interconnected with the four moulding units.

Coremaking Plant.

This incorporates the core ramming section from where stripped cores are conveyed on a steel band conveyor to

a large five stage vertical continuous drying stove which is gas-fired under complete automatic control.

The stove, an "Acme" patent vertical continuous core stove, manufactured by The Foundry and Engineering Co. Ltd. of West Bromwich, is 21 ft. high by 36 ft. long and 9 ft. wide comprising five conveyor loops, four baking and one cooling. There are 68 finger-arm auto-loading and unloading type trays, 7 ft. by 2 ft. with a height clearance of 28 ft. Suitable roller gear is fitted for loading core plates, and gravity rollers for automatic discharge of plates after baking and cooling are also provided.

The stove is driven by a 3 h.p. motor working on a supply of 400/440 volts, 3 phase, 50 cycles. Suitable change wheels are provided to vary the time cycle from 1½ hours to 4½ hours., the normal time circuit being 2¼ hours. A separate fan, powered by a 1 h.p. motor, provides the air supply to the stove. The gas burner is of the manufacturers own design, and normal gas consumption is in the region of 3,800 c. ft. per hour.

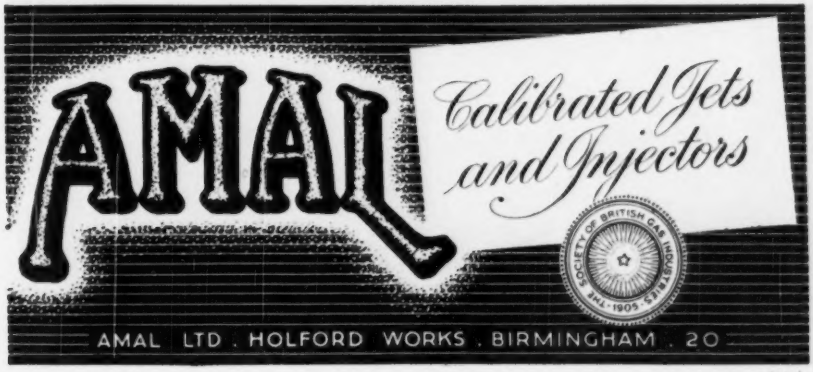
The automatic temperature controller recorder is manufactured by Ether Ltd., and is of the two point recording type. The controller operates the motor driven butterfly valve in the main gas supply line to regulate the temperature. As a safety precaution, an Ether "Flametrol" device is fitted to prevent the main gas supply being turned on before the pilot jet has been lit.

The silica sand used for coremaking is fed mechanically into a rotary gas-fired sand dryer, manufactured by August's Ltd., of Halifax, and capable of drying sand at the rate of 3-4 tons per hour, depending on the moisture content of the sand. The dryer is driven by a 5 h.p. electric motor through a "Radicon" reducing gear. A separate 2½ h.p. motor drives the fan for the air supply which is connected to a "Selas" gas burner. The consumption of gas on full load is approximately 2,200 c. ft. per hour. The sand is fed into the dryer from a rotary storage hopper of 40 tons capacity, and after drying it is conveyed and cooled by a suction lift system for a distance of 150 ft. to the 40 ton storage hopper, prior to mixing.

Fettling Plant

One of the 50 ft. bays is devoted to this operation. Castings are delivered here from the shake-outs by means of roller top traversers and elevator trucks. All castings are shot-blasted in airless rotary table machines, after which they are conveyed past the various fettling operational points on a production flow principle.

Two "Potterton Rex" gas-fired boilers are also installed at the Foundry, one for heating water for washing facilities, and the other for the provision of heat for the plenum ventilated lockers. These two services are required throughout the year, although the boilers are only used when the main heating system is not in operation, and normally the heat required for this work is supplied through calorifiers from the high pressure hot water side.



Hotel, Restaurant and Catering Exhibition, Olympia

JAMES STOTT & CO. (Engineers) LTD., had on show a number of new designs and developments which were well worth seeing at the Hotel and Restaurant Catering Exhibition at Olympia.

The fully automatic "Derby" boiler has novel features and in its streamlined birmabright case is pleasing to the eye. It has a high degree of efficiency and gas (or electricity) consumptions are phenomenally low. The "Derby" carries a reserve of 4½ gallons of boiling water.

A representative section of a Caféteria Counter was exhibited displaying a hot section with interchangeable containers and automatic water feed to bain marie, built-in refrigerator and masterset with under-counter boiler. The whole of the body of this unit is finished in blue vitreous enamel with stainless steel dishes, rails and fittings.

Of interest to all who are concerned with hygienic conditions in large scale catering is the Stott sterilising sink. This is a simple but efficient means of sterilising cutlery and crockery which is being insisted upon by the health authorities.

Also seen on the stand was a pedestal type of boiling pan with stainless steel interior which is a robust and handsome item of equipment.

In addition to the above there was a representative display of Regula café sets and boilers, Senior sets, Magna boilers, urns both plain and water jacketed. A full range of food-steaming ovens, all automatically controlled and in various finishes, were on view.

The two-pan "Autofry" range, constructed throughout of stainless steel with thermostatic control to each pan was of particular interest, also the selection of hot-cupboards in various finishes, all having roller bearing sliding doors, removable for easy cleaning.

RADIATION LTD.

RADIATION LTD. used their stand (No. 151/2) at the Hotel, Restaurant and Catering Exhibition at Olympia, London, to display items of cooking apparatus designed for all classes of large-scale catering, whether in hotels, restaurants, hospitals, schools, institutions or canteens.

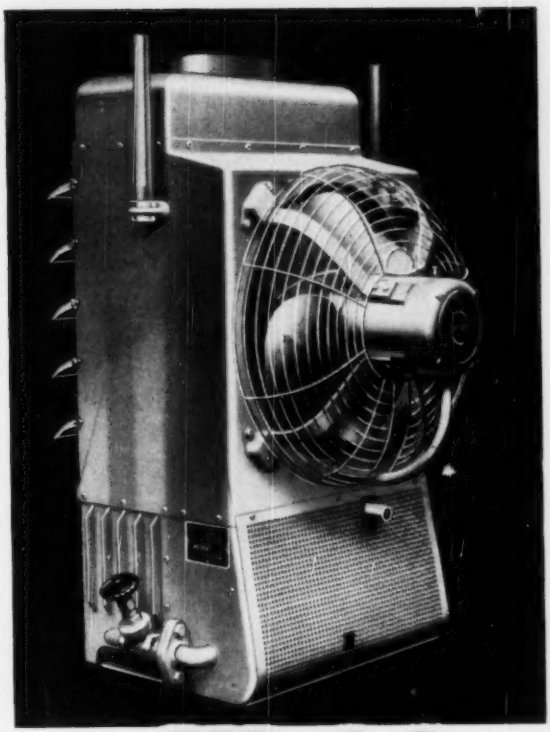
One of the most interesting items shown for the first time was a pressure steaming

A view of the James Stott Stand at Olympia

PLANNED HEATING AND VENTILATING GAS FIRED AIR HEATERS

These units are designed for space air heating and have a high efficiency together with all the other essentials of a good unit heater.

Weldex Gas Fired Heaters are only available at the present in one size, namely to give 94,000 B.Th.U. (with gas of 475 calorific value) per hour; sufficient for approx. 25,000 cubic ft. of room space.



The heating element is made from stainless steel to ensure long life.

They are fitted with automatic control cut outs to render them safe in the event of failure in gas or electrical supplies.

Operation of these units during the normal working period can be simply effected by switching on and off the electrical supply and, therefore, can be satisfactorily controlled by a standard thermostat if required.

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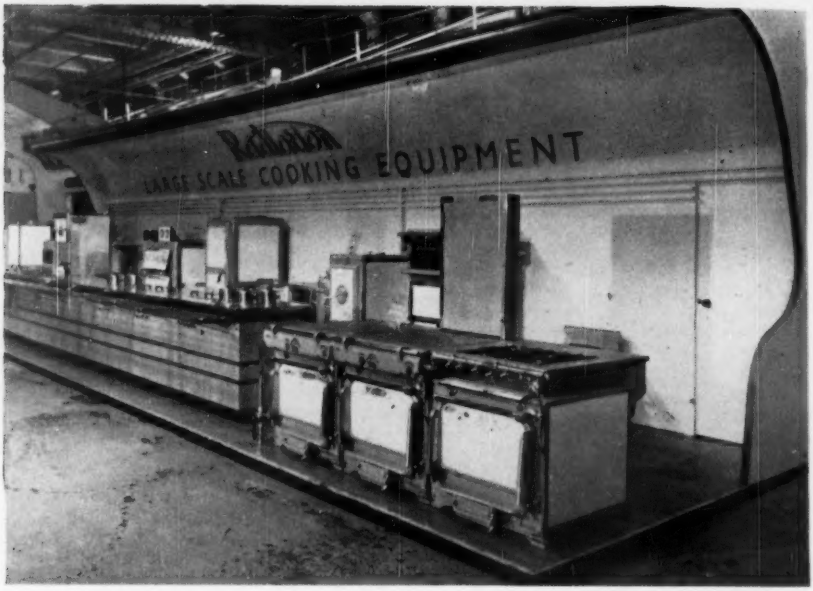


The stand of Radiation (Large Cooking Equipment) Ltd., at the Hotel, Restaurant and Catering Exhibition at Olympia, showing part of the 24 ft. long service counter and, in the foreground, a three-unit Grosvenor Range

oven. Operated by live steam, at five pounds pressure, it is available with compartments in three heights. Whilst all are 18 in. wide and 24 in. deep, the No. 2 oven is 16 in. high and accommodates three baskets (each of which has a capacity of 28 lb. of potatoes); the No. 4 oven is 28 in. high and takes six baskets; and the No. 6 oven is 40 in. high (eight baskets). The model at the Exhibition consisted of a No. 2 unit superimposed on a No. 4 unit, which will give an overall height of 5 ft.—the same as the height of the No. 6 oven.

BRICKWORK SETTINGS FOR CYLINDRICAL BOILERS

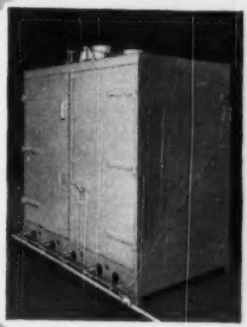
BRITISH standard 1614: 1949, price 3s., and obtainable from the British Standards Institute, 24/28 Victoria Street, London, S.W.1, deals with brickwork settings for cylindrical boilers based on a 30 ft. by 8ft. 6 in. boiler. It specifies the materials to be used and the methods of construction, under the headings of excavation, concrete raft, boiler brickwork and economizer brickwork. In addition, flue dimensions are specified. An Appendix sets out the Shell Boilermakers' Association's standard ratings for Lancashire boilers.

THE MASTER COOKER USES BOTTLE GAS

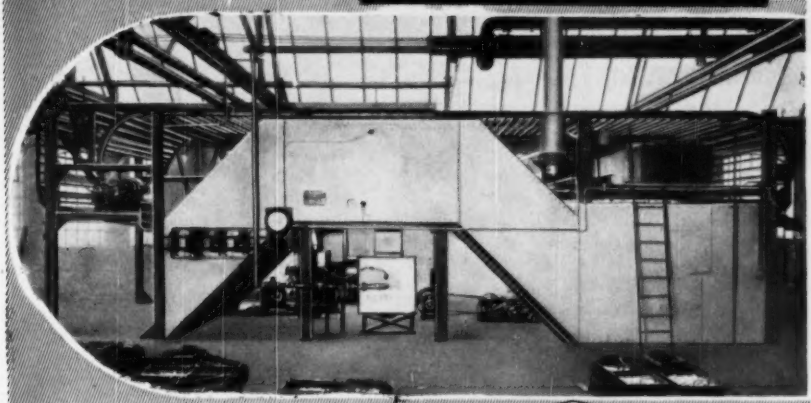
WE have received an interesting leaflet describing the BM20 "Easyclean" Bottle Gas Cooker, manufactured by Turley and Williams Ltd., Highgate Street Works, Birmingham 12. The well-known characteristics of the gas cooker have been preserved and design has been modified for use with bottle gas. The oven is thermostatically-controlled, is vitreous-enamelled throughout and brings town gas style cooking to country houses and larger buildings, which are outside the distribution limits of town gas.

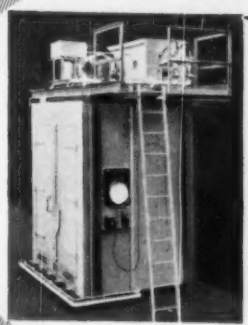
COMBUSTION ENGINEERING ASSOCIATION

THE annual dinner and dance of the Combustion Engineering Association will be held at the Dorchester Hotel, London, on 16th March. Application for tickets should be addressed to the Secretary, The Combustion Engineering Association, 24 Tottenham Court Road, London, W.1. Tickets are forty-five shillings each.



FOR INDUSTRIAL OVENS OF ALL TYPES





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J.T.L.

Gas Flame-Hardening of Large Gears

"WHAT is the cost of hardening large gears, and can I harden those which I now have on hand?" This question was put to an American manufacturer, who replied that the gears—in this case of 28 in. diameter with 5 in. face, made of low carbon or inexpensive steel—could be hardened only by first carburising and then hardening. It was pointed out that there was one drawback. Gears of such a size would most likely warp in the heat treating process to such an extent that they would become worthless. The cost of hardening such a gear, assuming its weight to be about 350 lb., would be approximately $35 each.

The comparatively high cost of hardening large gears is a problem which has been carefully studied in recent years by the Goodman Manufacturing Co., of Chicago. It was found that gear blanks of the correct size, made of 1040 steel, which is hardenable without carburising, could be purchased as a stock item from one of the larger steel companies.

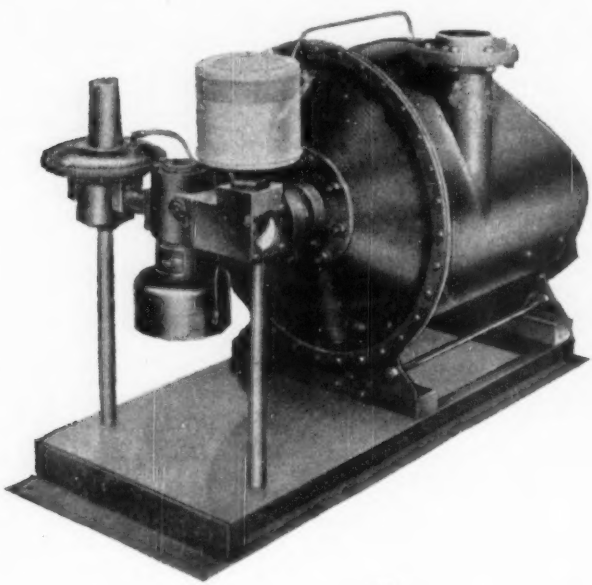
The blanks are completely machined in the usual manner, and are then ready for hardening. All available heat treating methods were thoroughly investigated by the Goodman Company. Aside from the fact that the gears had to be hardened with the minimum amount of distortion, long wearing quality and resistance to shock were the desired results.

Other Available Means

Before the method by which Goodman gears are now successfully flame-hardened is described, mention should be made of other available means, without prejudice as to the merits.

Electronic heating means have been widely advertised in connection with gear heat treating.

The use of high temperature gases, for instance, acetylene and oxygen, is advocated by the manufacturers of these products.



Gas and air mixing machine, to supply uniform mixture under various gas consumptions

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Illustration of a Town Gas-Fired Galvanising Bath 12′ 0″ × 5′ 6″ × 4′ 6″.

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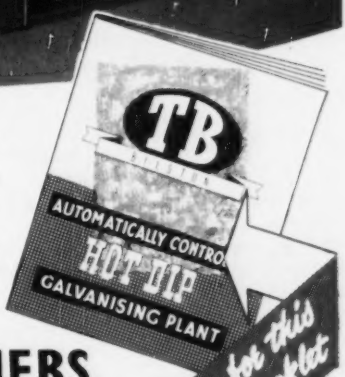

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Gas is Best

Both heating means have their place in the art of localised heating. The industrial gas engineer should study such methods carefully. He will then discover that gas is best fitted for certain flame hardening applications.

Goodman Manufacturing Co. hardens its 28-in. gears by spinning them within a cluster of high velocity burners, supplied with a complete mixture of gas and air.

The theory of localised heating or flame hardening necessitates the utilisation of the highest flame temperature which combustion of gas with air is capable of producing. It also requires that the surface or part to be hardened be subjected to a stream of such high temperature gases under the greatest possible velocity.

A gas and air mixture machine is the best means of supplying a uniform mixture under various gas consumptions.

Naturally various amounts of gas-air mixture and different numbers of burners are used for larger or smaller gears.

Special Burners

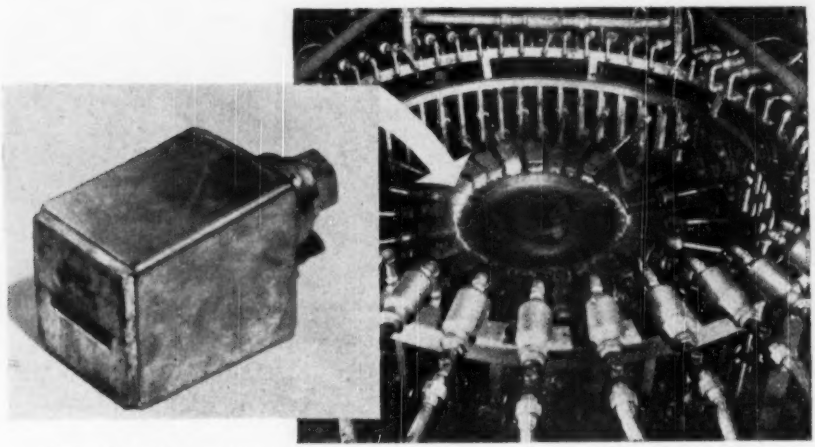
High velocity gas burners require good flame retention means. Special burners of this type have built into the burner mouth, or outlet, a unique piloting means. Further flame retention and combustion are achieved through a zig-zag passage of a refractory tunnel, from which the burner derives its trade name—"Zig-Zag."

A total cycle of pre-heating, soaking, final heating, time quenching, and flame drawing requires 10 minutes per gear. The total cost of gas consumed, together with labour cost, works out at a very low figure.

It seems that industrial gas will play an important *rôle* in the art of flame hardening on account of its low cost.

To harden gears without any distortion at all is practically impossible, and therefore some gears must be finish ground after hardening so that they will run quietly at high speeds.

Anyone who has seen a flame-hardening operation will have noticed that only one gear is being heated at a time, but there is no sound reason why it should not be possible to harden four or five gears at one time with gas and air.



Flame-hardening a large spur gear with gas and air, using a zig-zag burner. Gear is 28 in. OD × 5 in. face, used in electric locomotives

Hardness Pattern

The question of hardness pattern should be touched upon. It is still a very controversial subject among metallurgists. However, it can be stated that wear and shock resistance or tooth strength only require definite hardness patterns. How to obtain

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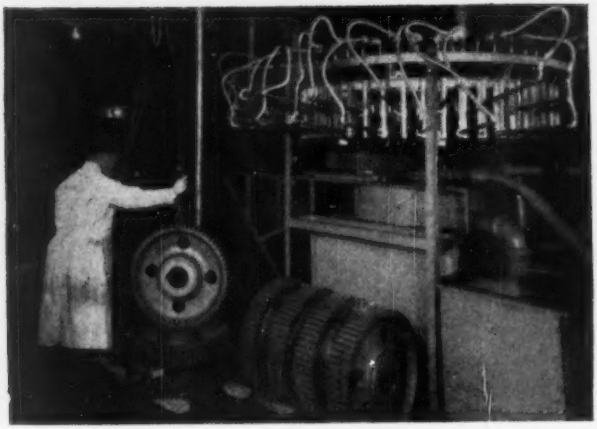


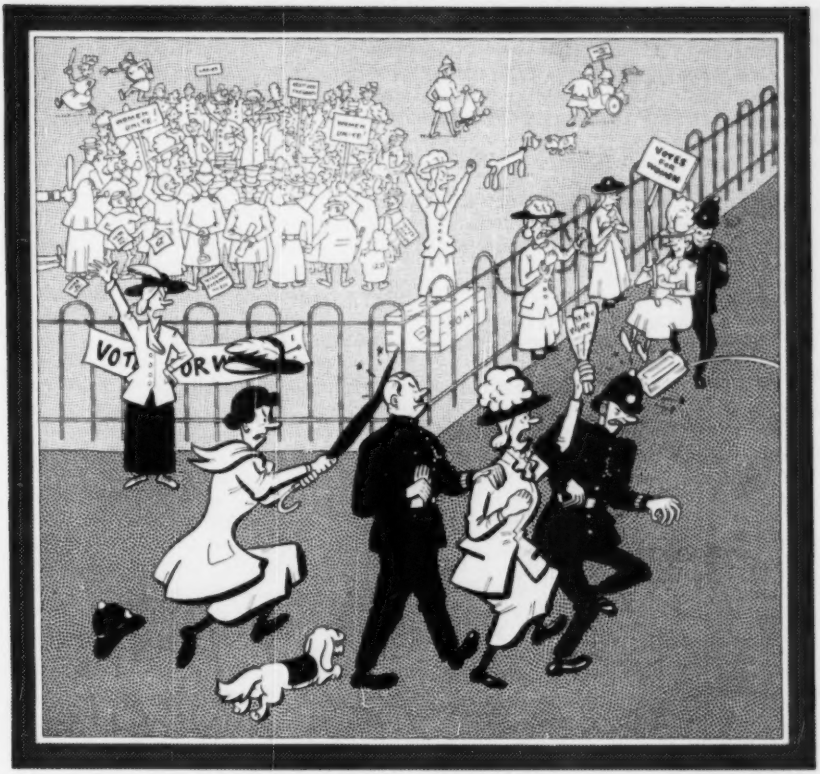
High-velocity gas burner at right was designed for good flame retention in hardening large gears

these with various tooth cross sections is still to be explored.

Ordinarily, machine tools such as lathes, milling machines, and drill presses can function conveniently as flame hardening machines if provided with certain attachments such as demountable burners and quench tanks. For example, take the radial drill. If a burner arrangement were attached to its main post and a quench tank placed on its table, the machine would be ready for flame hardening gears. Further, it should be remembered that the first successful experiments with gas and air flame hardening were made on a milling machine.—(*Gas*, November, 1949).

General view of the stand of Radiant Heating Ltd., at the Hotel and Catering Exhibition. Among the products displayed, those which attracted special attention were the "King-Toaster," the "Floortherm" heater and the "Salamander" griller

Refractory people made History . . .



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Industrial Gas Goes Ahead in Johannesburg

by

Colonel W. R. GORDON, O.B.E., M.Inst.F.

WITH the rapid industrial development which has been taking place in South Africa since the war, there has been a steady growth in the use of gas for a variety of processes. In the factory suburb of Industria, to the west of Johannesburg, a wide number of industries are already employing gas, because of its cleanliness, convenience and ease of control.

Amongst the gas users in this industrial suburb are manufacturers concerned with food processing; the preparation of paints, including resin melting; laboratory work and the melting of waxes for polishes; the drying of rock salt and breaking it down for domestic use; the melting of metals for die-casting; metal spraying and the bronzing of steel windows; drying tobacco; the manufacture of motor-car batteries, including the making of cases and coating of the lead plates; sinks, cupboards and other kitchen furniture for which soldering irons and enamelling furnaces are required; the melting of lead prior to pipe drawing; linotype and other printing processes; the plastic covering of electric wire and various others. So important, in fact, is this area becoming that Johannesburg municipal gas undertaking will shortly complete a special 9-in. ring main right around this district.

A Large Consumer

In other parts of Johannesburg, too, industrial uses for gas are multiplying rapidly. One of the biggest consumers is the Carlton Hotel, which is, however, only one of the principal hotels, most of which employ gas for cooking and for other purposes. The Carlton Hotel alone uses one million c. ft. per month.

Among other industries, which favour gas for process work are manufacturers of steel windows, wire springs, reinforcement wire for concrete construction; spring mattress makers; metal box manufacturers, as well as firms making neon and fluorescent electric lamps. Almost all the sweet manufacturers are large gas users. All the municipal workshops employ gas for a variety of needs, as also do most of the printing works, while both the South African Railways motor transport and electrical workshops are important consumers too.

The spring mattress makers, referred to above, have a large Selas plant and are, presently, installing a furnace for tempering. New users will include a firm making pneumatic drills for the mines, and who are putting in no less than five furnaces for drill sharpening purposes. Their estimated consumption, once they are connected up and fully in production, will be three million c. ft. per month. Yet another new user will be a toy factory, whose parent concern is situated at Birmingham.

Assembling Electric Lamps

Amongst the most interesting industrial gas consumers is the firm of African Lamps (Pty.) Ltd., that, for the past four years (of which the last has been in their present factory), have been assembling electric lamps with the help of gas operated plant. This firm is, at present, turning out approximately 2,000,000 lamps a year, but this figure will be increased considerably as soon as the additional plant, now on order, has been received. The standard plant for the production lines consists of an exhauster and inserter, supplied by the Hoffman Manufacturing Company, U.S.A., and stem-making, sealing-in and capping machines made by F. H. Anstey and Co. Ltd. of Bedford.

Although, at present, all the raw

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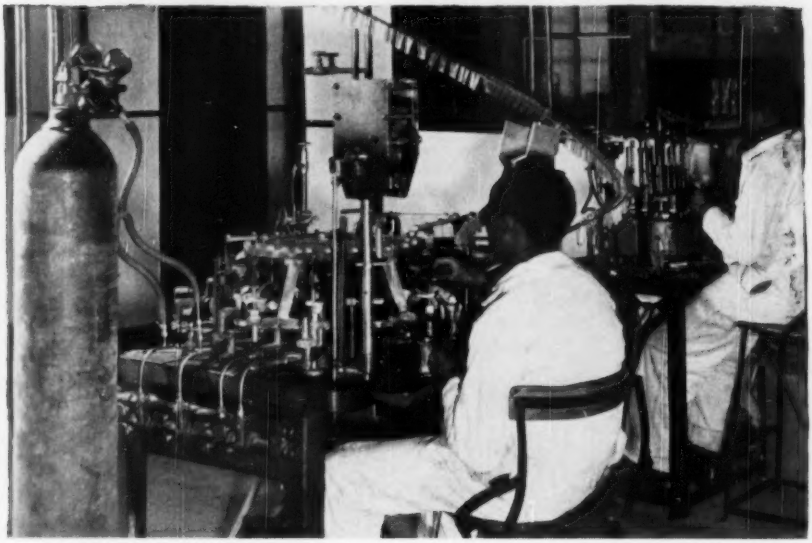
materials, except the town gas, nitrogen and oxygen, have to be imported, the labour is almost entirely Native. There are three technical staff, of whom Mr. Barlow, the works manager, has recently come out from England; nine European girls are engaged upon mounting the filaments on to the stem, while the remaining 49 on the operative staff are Natives. This repetitive work seems to suit them very well and they pick it up quickly. In fact, for sheer persistency in performing comparatively dull routine jobs, the Native compares favourably with his European counterpart overseas, though, naturally, he is not so adaptable nor so intelligent, except in a few instances.

The gas is provided to the factory by a 4-in. service, through a 3,000 ft. per hour conventional meter. It is picked up by the Selas plant for gas and air mixing and here governors maintain a balanced pressure. The average hourly consumption is 1,200 c. ft. or about a quarter of a million monthly.

Details of the Process

In the actual assembly process itself the flanges of the lamp are first shaped and cut by gas, in a machine continually fed from above by glass tubing of 12 millimetre diameter and with a thickness of only one millimetre. The flaring is done by a forming tool which rotates at high speed in the centre of the glass in the opposite direction to that of the glass itself. At this stage, too, the glass flange is annealed. In the next machine the molybdenum wire is inserted and the stem made. The assembly is then passed to the European girl operators in another room, where the filament is mounted on to the stem by hand, a process requiring skill, care and good eyesight, especially in view of the fine texture of the filament. The assembly is then passed back to the machine line, on trays mounted on trolleys, for the filament to be dipped in the phosphorus "getter," already suspended in an alcohol solution. This "getter" is necessary to ensure that when the lamp is first ignited all the gases,



Stem making (nearest the camera) and stem inserting: The stem machine is fed with flanges, exhaust tubes and rods automatically, the operator feeding the two electrodes by hand. This machine is capable of producing 700/750 stems per hour. The inserting machine forms a button on the end of the stem rod and inserts the molybdenum wire into this button, at the same time cutting the wire to the required length and forming the "pigtail" at the end of the wire, this being necessary in order to retain the filament in position. This machine is capable of inserting 3,500 supports per hour

This photograph shows part of the assembly line from sealing in to packing, including sealing in, exhaust and filling, assembly cap to bulb, baking cap to bulb, soldering, flashing and gas testing, cleaning and packing. All these operations are carried out by native labour

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except the argon-nitrogen, with which the lamp is filled later, shall be driven back to the walls of the lamp, so as to allow the filament to burn in an atmosphere of argon-nitrogen alone.

The stem is next sealed into the glass bulb and the bulb evacuated of all air. Then the bulb is filled, as near atmospheric pressure as possible, with argon-nitrogen. The cap is fixed to the bulb at this stage, inserted over it, and the sole plates soldered. The newly assembled bulb is then tested on a high frequency gas sparker for the purity of argon gas and afterwards flashed at 10 per cent. over voltage as a preliminary test of efficiency. All the gas jets are directed exactly in the direction required, during the manufacturing process and, as the machines rotate, all the Native operator is called upon to do is to place the so-far completed assembly in the place provided on the machine and to take off the partly finished part, ready for the next operation at the machine.

It speaks well for the Johannesburg gas supply that the jets themselves keep clean and free from impurities. A close watch is, of course, kept upon both temperatures and pressures.

After coming off the line the lamps are bonded for 24 to 36 hours. A percentage check is then taken by running a number of lamps for one hour at their rated voltage. A further percentage of the daily production is also tested at the rated voltage for 1,000 hours, during which they are switched off every twelve hours for a period of fifteen minutes.

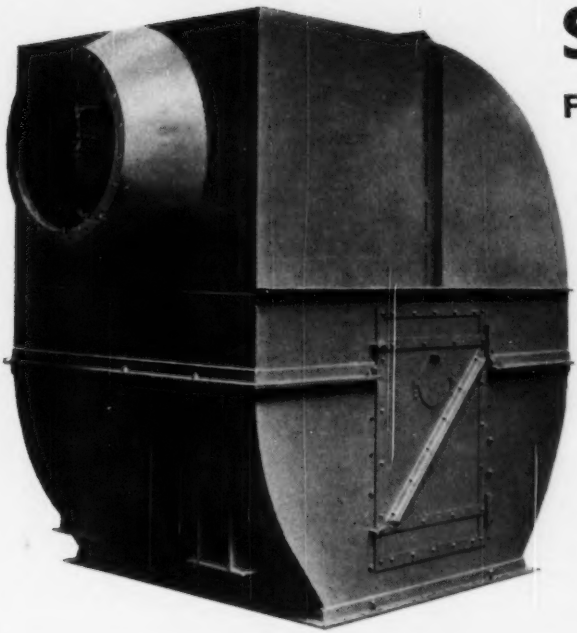
There is plenty of room for expansion in this factory, even after the third assembly line, now on order, has been installed. There is, thus, every scope for an increased utilisation of gas in this particular industry, which shows so well how gas and electricity can operate in complementary fashion, to the advantage of industry.

Extensions to Swansea Technical College

ON this page we illustrate the exhibit arranged by the Wales Gas Board in connection with the official opening of new extensions at Swansea Technical College by the Rt. Hon. George Tomlinson, M.P., Minister of Education.

Gas-fired appliances play an important part in many of the College's departments. The heat

Showing some of the exhibits arranged by the Wales Gas Board. Note the model house used for instruction of gas fitters



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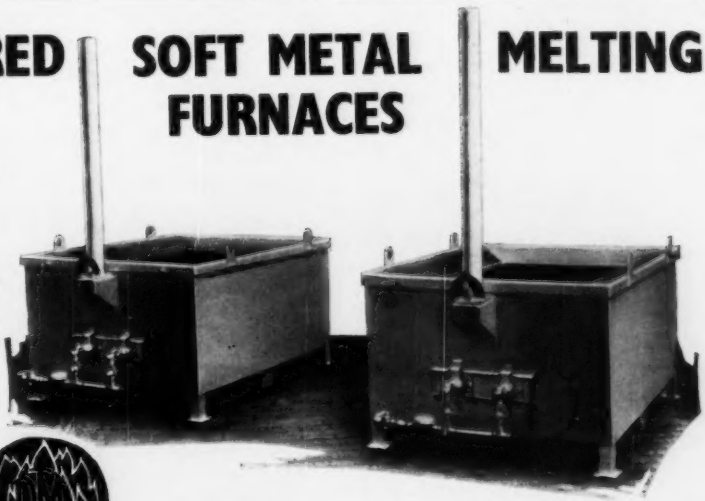

Illustration shows two Furnaces used in the Tinning of Milk Churns

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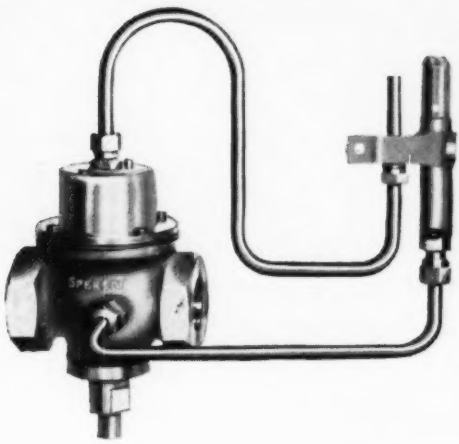

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